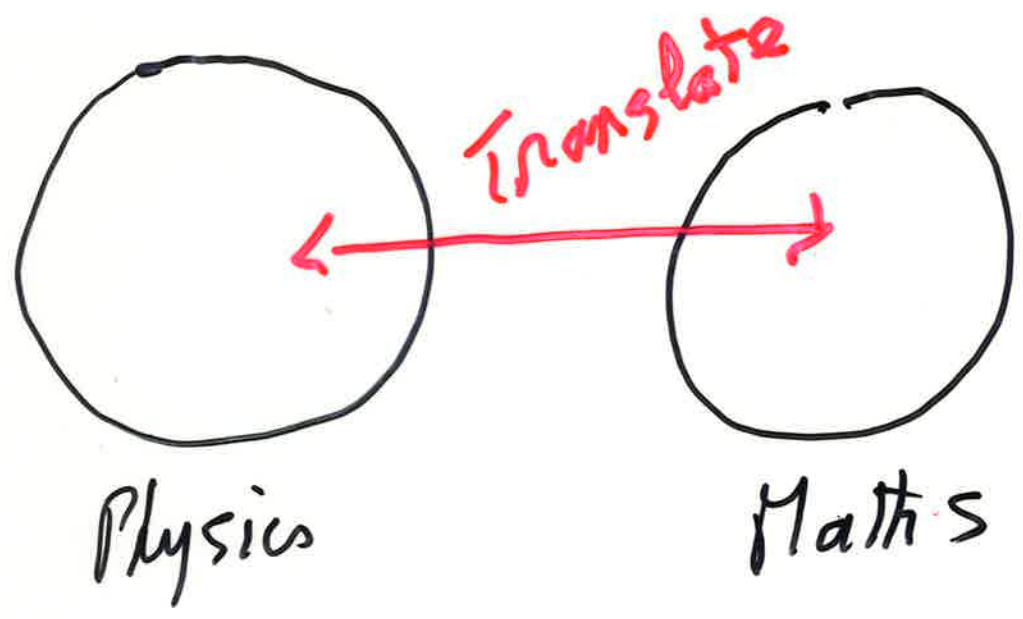
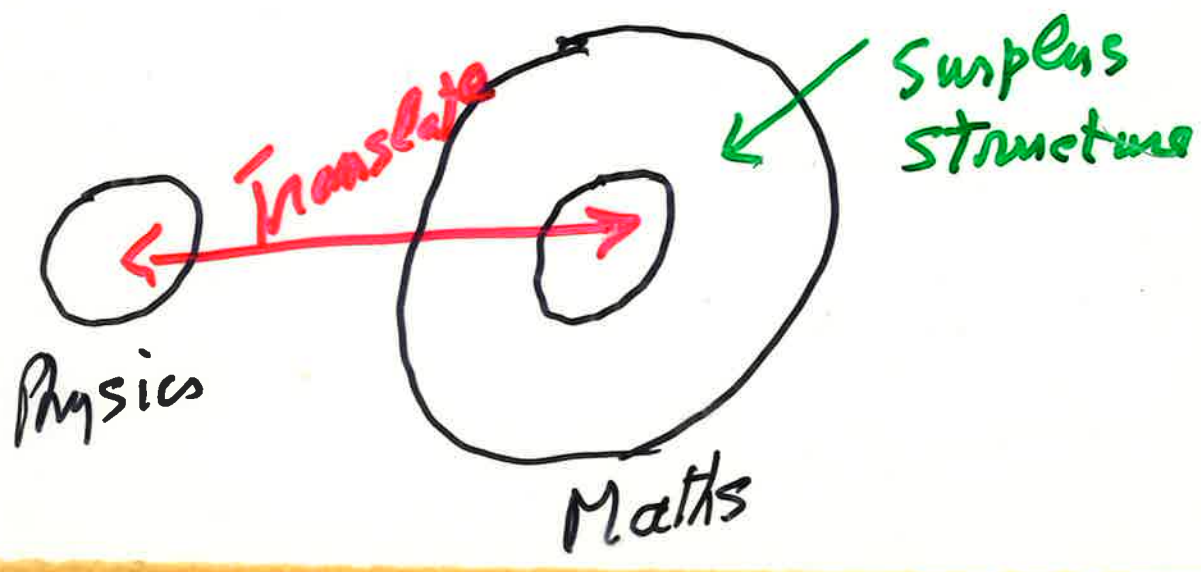


# THE RÔLE OF MATHEMATICS IN PHYSICS



## SURPLUS STRUCTURE



# Ghosts in Particle Physics —

Steven Weinberg, Quantum Theory of Fields  
Vol 2, 1996

## 15.6 Ghosts

25

Section 9.5, the determinant of any matrix  $\mathcal{F}_{\alpha x, \beta y}$  may be expressed as a path integral

$$\text{Det } \mathcal{F} \propto \int \left[ \prod_{\alpha, x} d\omega_{\alpha}^*(x) \right] \left[ \prod_{\alpha, x} d\omega_{\alpha}(x) \right] \exp(iI_{GH}), \quad (15.6.1)$$

where

$$I_{GH} \equiv \int d^4x d^4y \omega_{\alpha}^*(x) \omega_{\beta}(y) \mathcal{F}_{\alpha x, \beta y}. \quad (15.6.2)$$

Here  $\omega_{\alpha}^*$  and  $\omega_{\alpha}$  are a set of independent anticommuting classical variables, and the constant of proportionality is field-independent. (We have to

# TIBETAN GHOST TRAP

(13)

